Poor lighting diminishes radio-diagnostic accuracy

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Ambient light and display luminance contribute significantly to diagnostic viewing conditions in the digital radiology reading room.

For radiologists, although the transition from film-based to digital display has dramatically changed their viewing environment, issues of ambience and illumination continue to impact accuracy and reliability. In the film-based reading room, images are hung on backlit view boxes. Standards determine illumination levels for both general or more specialized use, such as inspection of mammograms. There are also known optical density ranges for the films themselves, determining how much light gets through. A dedicated ‘bright light’ is employed to enhance visibility of specific structures and darker images. To avoid interference from stray light, unused view box panels can be turned off or covered with blank ‘masking’ films, and ambient light levels are also important to ensure visual adaptation and to reduce the effects of glare. We recently move to reading digital images on computer monitors, which has not eliminated the importance of optimizing both luminosity from the display and ambient light. With respect to the former, early in the transition we carried out a study to determine if monitor luminance influenced diagnostic performance and whether visual search variables—such as total reading time or time expended to render a diagnostic decision, were affected.1

Six radiologists viewed a series of 50 mammograms on an 80fL monitor (1 footlambert is equal to approximately 3.4 candelas per meter) and on a 140fL monitor. Using a system that tracked point of gaze, eye position was recorded during the inspection for masses and microcalcifications. Surprisingly, performance on both monitors was similar. However, visual search parameters showed significant differences. Total viewing time, as measured from the appearance of the image to the decision rendered, was significantly shorter with the higher luminance monitor, about 4s on average. This translated into significantly shorter time spent directly inspecting or fixating individual lesions. In summary, brighter displays enabled faster discovery and identification of lesions. This study suggested that such monitors could improve workflow, and today brighter displays are the norm. At what point a softcopy display becomes too bright for the human visual system appears to be unknown.

Veiling glare, the diffuse scattering of light within the display device, can also affect performance. We showed six radiologists a series of 160 mammographic images that had been processed to simulate several levels of veiling glare, ranging from none to typical to twofold and fourfold CRT.2 Accurate diagnosis decreased (see Figure 1), with significant effects at 4× CRT. Cathode ray tubes typically deliver more veiling glare than LCD displays, and with current trends in radiology favoring the latter, it is likely that this issue will diminish in importance. It may not be eliminated completely, however, because many manufacturers position a protective shield in front of LCDs to avoid fingerprints. The shield itself can contribute to veiling glare.

To avoid the more common effect of glare from overhead lighting, it is important to consider ambient room light and to avoid bright white lab coats and similar articles of clothing. Objects in the reading room (e.g., desks, walls, flooring material) can increase glare, while ambient light in general has been shown to influence diagnostic accuracy. Reading rooms that are too dark or too bright can also degrade performance. Ambient settings between 25–40lux are optimal in most radiology viewing conditions. However, to the extent that the human eye will adapt

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to changes in display luminance, brighter monitors may allow heightened levels of ambient light.

When display luminance and ambient illumination affect diagnostic accuracy, they impact overall workflow. Today, radiologists examine an ever-larger number of images, both in absolute terms and per study, especially with the use of magnetic resonance (MR) and computed tomography (CT). Optimizing the reading environment is requisite for improved reader efficiency. Future research will measure the effects of still higher luminance displays and investigate whether and to what extent aging displays affect diagnostic and search performance.

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References